Interpretation of the TexAQS Radical and Aerosol Measurement Project (iTRAMP)

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HARC TRAMP

A unique dataset of atmospheric parameters has been acquired by various research groups during August and September, 2006 within the TRAMP project. The observations include:

- atmospheric pollutants: O_3, PANs, CO, NO, NO_2, SO_2, VOCs
- major radical species: OH, HO_2, and NO_3
- radical precursors: O_3, HCHO, HONO, VOCs
- termination species: HNO_3, H_2O_2
- soluble gases: nitrate, nitrite
- radiative properties: actinic fluxes, AODs, aerosol absorption and extinction
- aerosol physical and chemical properties
- meteorological data: T, WS, WD, LIDAR
- vertical and horizontal distribution of O_3, NO_2, HCHO, SO_2, HONO, and aerosol
- OH reactivity

MOTIVATION

The interpretation of this dataset promises to advance our understanding of atmospheric processes as they contribute to air pollution in Houston and other urban areas.

We propose a strategy to interpret the TRAMP data set based on four overreaching themes:

- Emissions profiles of atmospheric constituents
- Radical chemistry
- Aerosol physics and chemistry
- Mixing and transport of atmospheric constituents

HARC TRAMP

Many participants will contribute to more than one of these themes. There is considerable advantage to a thematic approach, in contrast to an interpretation of data sets of individual researchers:

- By concentrating on scientific questions rather than individual datasets the interpretation activities will be more focused and efficient.
- The existence of a data set allows the selection of specific scientific question that can be successfully answered.
- The thematic approach will foster the collaboration between the TRAMP participants and outside collaborators.

Emissions profiles of atmospheric constituents

Lead: Rappenglueck and Luke

Questions to be addressed:

- Emission profiles of VOCs, CO, NO_x, and SO_2
- Source determination; also addressing possible primary sources for formaldehyde by using supposedly coemitted trace gases (CO, NO, SO_2)

	F1	F2	F3	F4	F5
CO		0.85			
ethane	0.84				
ethylene	0.61	0.50			
acetylene		0.82			
propane	0.82				
propylene	0.67				
i-butane	0.93				
n-butane	0.92				
t-2-butene			0.89		
1-butene	0.53		0.53		
i-butene				0.82	
c-2-butene			0.81		
cyclopentane	0.76				
i-pentane	0.85				
n-pentane	0.64			0.58	
t-2-pentene		0.59	0.70		
2-methyl-1-butene			0.78		
1-pentene		0.61	0.58		
c-2-pentene		0.57	0.69		
2,3-dimethylbutane	0.58	0.58			
2-methylpentane	0.70	0.54			
3-methylpentane	0.68	0.57			
isoprene					-0.91
benzene	0.53				
toluene		0.82			
ethylbenzene		0.77			
m,p-xylene		0.84			
o-xylene		0.87			
1,3,5-trimethylbenzene		0.82			

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

	Possible sources
F1: all alkanes, some alkenes, benzene	industrial, gas evaporation
F2: CO, some alkanes, some alkenes, acetylene, aromatics	vehicular combustion, (solvent usage)
F3: C_4 - C_5 alkenes	industrial
F4: i-butene, n-pentane	(liquefied petroleum gas)
F5: isoprene	biogenic

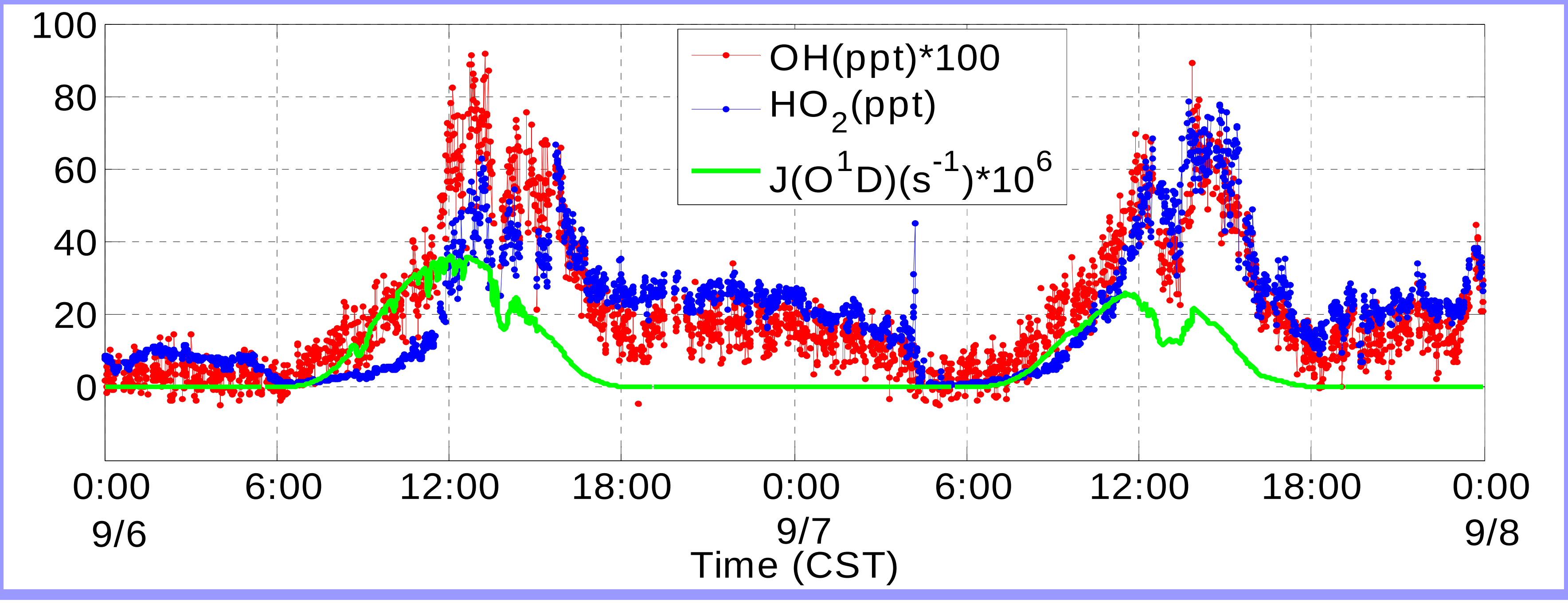
many compounds of F1 - F3 show correlations with CO

Radical Chemistry

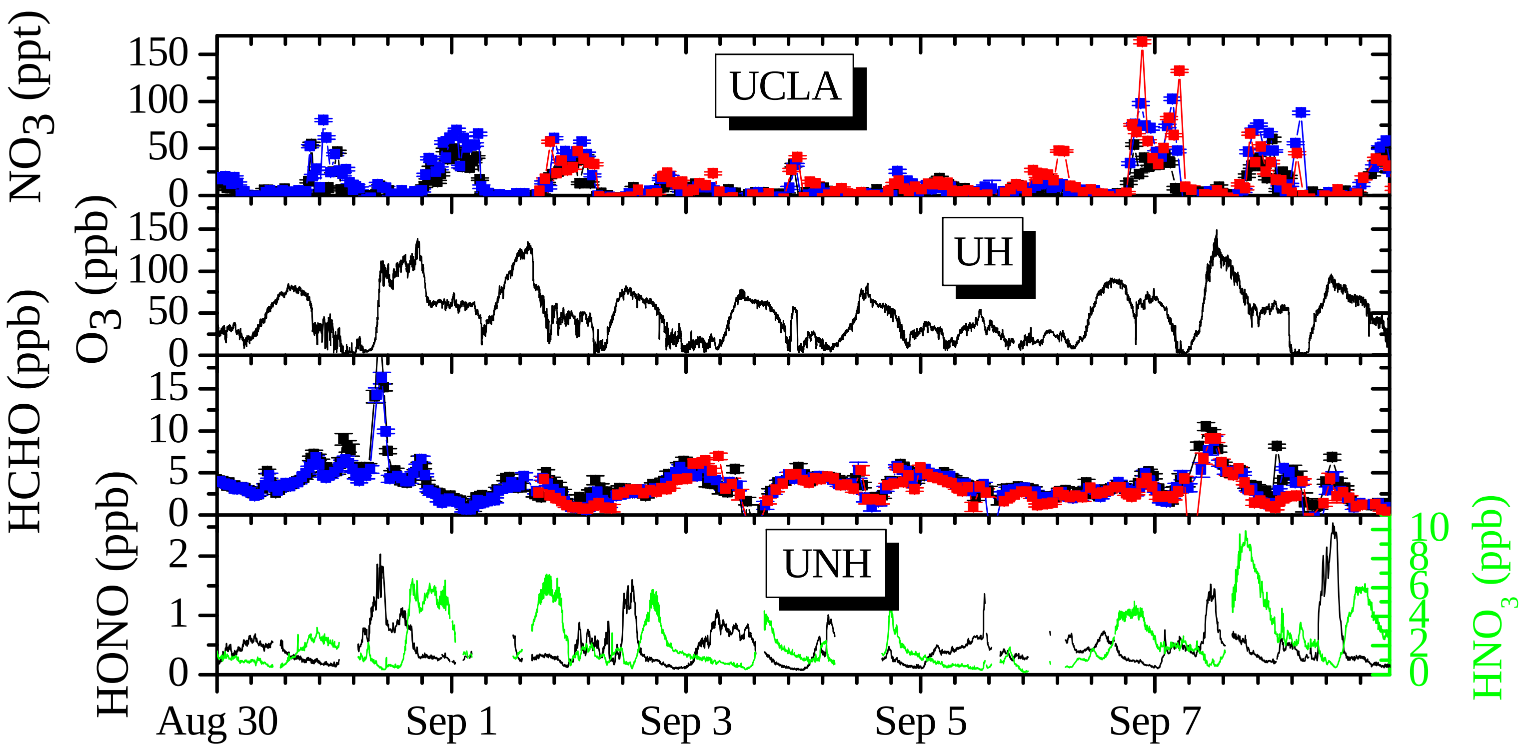
Lead: Brune, Lefer, Rappenglueck, Dibb and Stutz

Questions to be addressed:

- OH reactivity and ozone formation
- O_3, HCHO, HONO and O_3-olefin reactions as sources for radicals
- HNO_3 and H_2O_2 as radical chain terminating species
- Nocturnal radical chemistry
- Daytime and nighttime NO_x budget
- Influence of aerosol and clouds on radical levels and ozone formation



Daytime and Nighttime Radical Chemistry

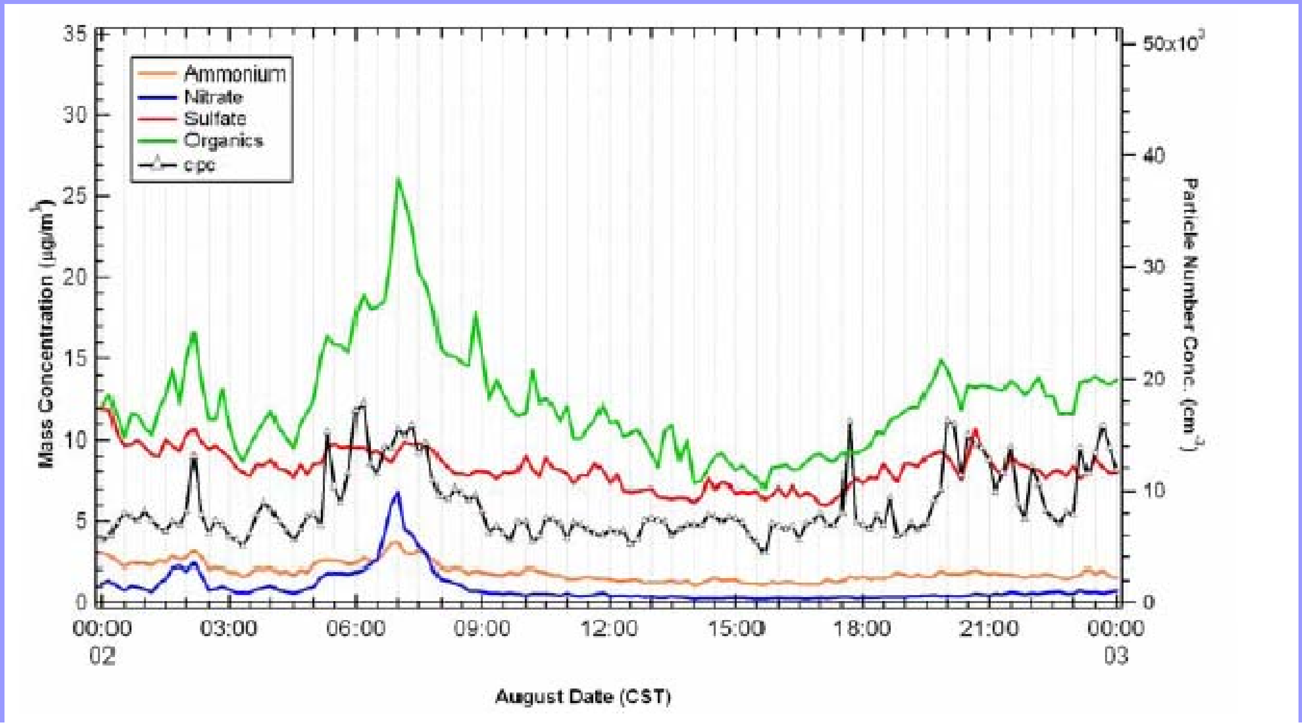


Aerosol physics and chemistry

Lead: Griffin, Atkinson and Dibb

Questions to be addressed:

- Chemical and physical characterization of Houston aerosol (i.e., contribution of sulfate and organics, relationship between aerosol constituents and size)
- Optical properties of aerosol and their impact on chemistry and climate
- Estimation of secondary organic aerosol (SOA) formation

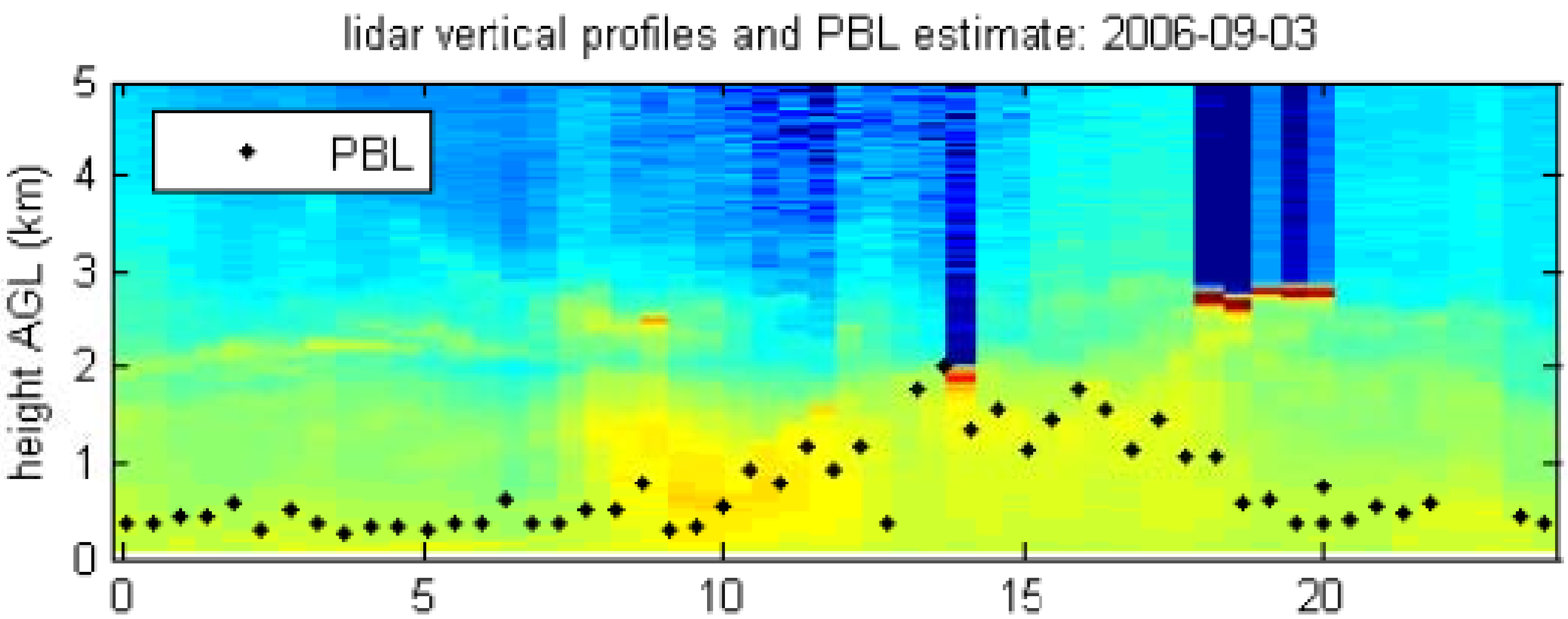


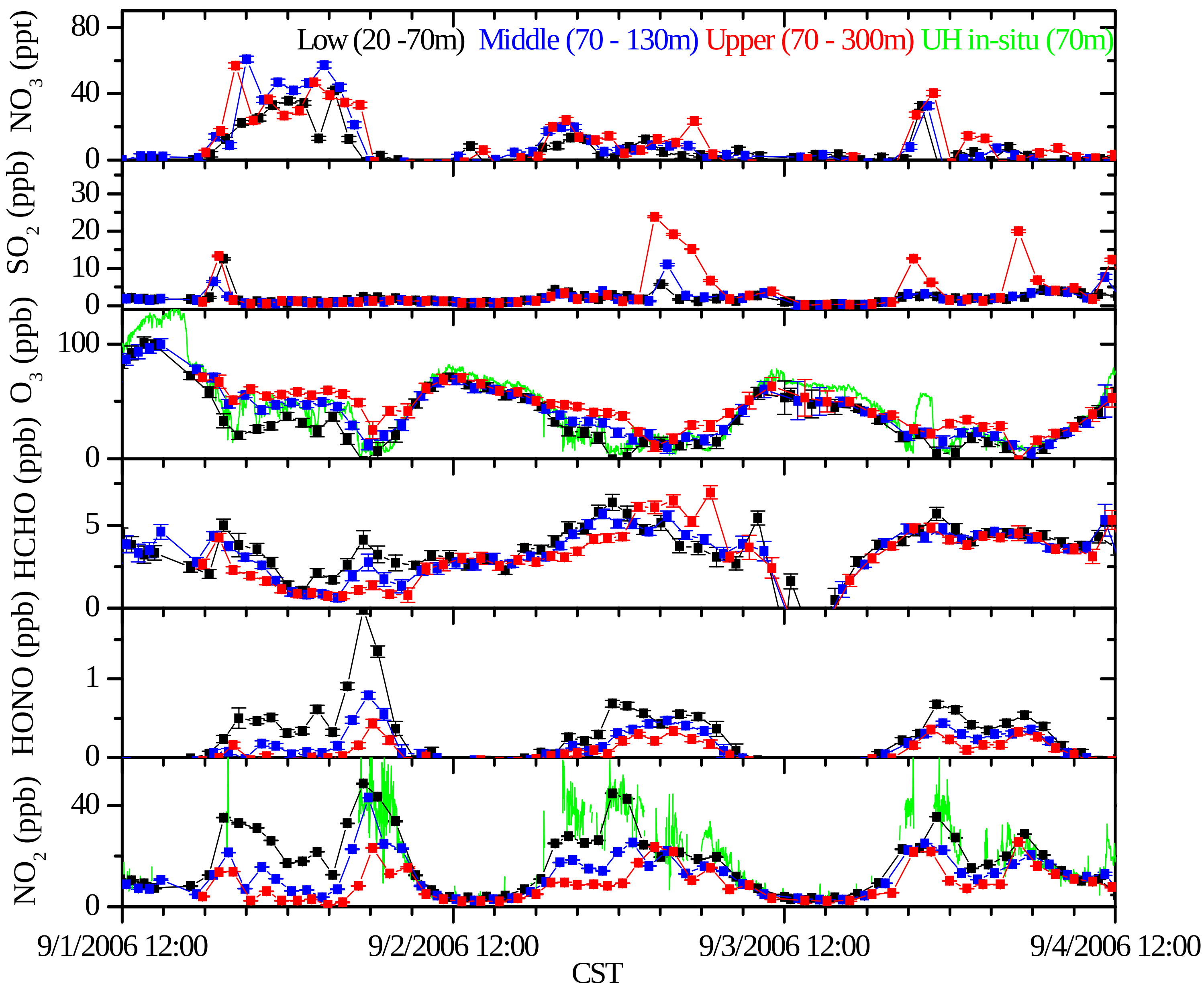
Mixing and transport of atmospheric constituents

Lead: Stutz and Flynn

Questions to be addressed:

- Transport and chemistry in the stable urban boundary layer
- Heterogeneity of the spatial distribution of trace gases and aerosols. Impact of plumes and BL height.
- The morning transition chemistry vs. transport





Low (20 -70m)
Middle (70 - 130m)
Upper (70 - 300m)
UH in-situ (70m)
NO_3 (ppt)
SO_2 (ppb)
O_3 (ppb)
HCHO (ppb)
HONO (ppb)
NO_2 (ppb)
80
40
0
30
20
10
0
100
0
5
0
1
0
40
0
9/1/2006 12:00
9/2/2006 12:00
9/3/2006 12:00
9/4/2006 12:00
CST